Docket No. 56967

AUTOMATED BULK BOX STRAPPER

Background of the Invention

This application claims the benefit of provisional application serial number 60/192,152, filed March 24, 2000.

Field of the Invention:

This invention relates to the strapping of bulk boxes, and more particularly, to a machine for the automated strapping of bulk boxes.

Prior Art:

Containers have been developed in the prior art for the bulk storage and shipment of a variety of materials, including meat products, agricultural produce, flowable goods, and other consumer and industrial products. These containers are commonly referred to as bulk bins or bulk boxes, typically varying in size from forty to sixty inches deep and thirty to forty inches wide, and capable of holding and supporting in excess of four thousand pounds of goods.

Bulk boxes are made of various materials, but commonly employ corrugated cardboard in their construction. Liners are sometimes used to improve the strength of the boxes and to insure leakproof containment of the goods held therein.

The internal contents of these boxes, often fluid, provide minimal support of their own weight and rely upon the structural integrity of the container to support the full weight of the contents. Bulk boxes, unlike most corrugated containers, must resist strong forces in both horizontal and vertical directions. These conditions can

cause the sidewalls to bulge outwardly and possibly fail. To alleviate this problem, one or more, typically four to eight, external reinforcing bands or straps of plastic or metal are sometimes applied to the boxes.

In the prior art, the reinforcing straps are manually applied to the boxes, generally with the boxes in a knocked-down or flattened state. This process is time-consuming and expensive, with the ratio of the cost of labor to the cost of materials often as much as 4:1.

Machines are known in the prior art for applying strapping around objects, including boxes, for bundling them together. The heaviest, or largest, strapping that can be handled with these machines is four hundred pounds. Reinforcing strapping as used in the present invention is typically six hundred pound strapping. Applicant is not aware of any prior art machine that applies reinforcing strapping to a container, or any bundling strapper that is capable of handling strapping larger than four hundred pounds.

Accordingly, there is need for an economical system and method for applying external reinforcing straps to bulk boxes.

Summary of the Invention

In accordance with the invention, an automated system and method are provided for economically applying reinforcing straps to bulk containers.

With other costs remaining constant, the system and method of the invention enables external reinforcing straps to be applied to bulk boxes at a ratio of the cost of labor to the cost of materials of about 1:3, or a 12:1 improvement over the prior art.

The invention comprises an automatic strapping machine that applies one or more straps externally to a bulk box to reinforce the box. More specifically, the

strapping machine of the invention applies a plurality of reinforcing straps around the outside of the box in spaced apart relationship along the length or height of the box, while the box is in its knocked-down or flattened condition. The straps can be uniformly spaced apart, or the straps nearer the bottom of the box can be spaced more closely together than the straps toward the top of the box, depending upon the requirements of a particular application. From four to eight straps are generally applied to a box, although this number can vary as desired or required.

The strapping machine of the invention has a plurality of strapping stations or stages through which the box, in a knocked-down or flattened state, passes for sequential application of the straps to different locations on the box. The straps are applied by strapping head assemblies positioned at the strapping stations, each of which receives a length of strapping material from a supply reel, encircles the box with a strap, secures the strap in encircling relationship to the box, and cuts the strap encircling the box from the length of supply strapping in preparation for continued movement of the box to the next station. Suitable sensing means, such as photocells or microswitches and the like, are positioned at each station to sense the position of the box and stop it in a predetermined location for application of the straps.

Each station may be constructed as a separate module having two strapping head assemblies. A single disconnectable data and power connection is provided. Each module will be large enough to hold an entire bulk box in process. All of the modules can be identical and interchangeable with one another, but the last module in a series preferably comprises a recovery module to apply any straps that were missed in an earlier station.

Further, the modules can operate independently of one another. That is, inoperability of one module, or one or more strapping heads at a module, will not affect the operation of another, except that a recovery module can apply any missing

straps. This enables one or more strapping heads or modules to be taken out of service and the machine can still operate. Straps that would have been applied by the inoperable strapping head are applied by the recovery module, which can apply all of the straps if all of the preceding heads are inoperable.

In a preferred embodiment, two strapping head assemblies are provided at each station, with each head assembly arranged to position a strap at a predetermined location on the box. The head assemblies at subsequent stations are positioned to apply further straps at different predetermined locations on the box. A last station that normally is not utilized may be provided to apply a strap or straps that were inadvertently not applied at a preceding station.

An infeed can be provided to supply boxes to the machine to be strapped, or boxes can be hand fed to the machine. A stacker preferably is positioned to receive strapped boxes from the machine. As a box is called into the machine, any boxes in the system all shift one module toward the outlet. After module 1 has called for a box and all boxes have shifted downstream into place, all strapping head assemblies will activate. For a four station machine, with the fourth station serving as a recovery module, there will be six boxes in process at any given time. Each module will have a box ready for strapping, one box will be in the infeed ready for the next start cycle, and one box will be in the stacker. Each module, except the fourth in this example, will apply two straps on the box. The recovery (fourth) module will apply any missing straps. The cycle time for each strapping station is about 6.4 seconds, and approximately 545 boxes per hour can be strapped.

The placement of positioning of the straps, and initiation of operation of the strapping heads at each module, are controlled by sensors that detect the position of each box at a station and operate to cause a limit stop to move into the path of the box to halt its movement through the station at a predetermined position for

placement of the straps applied at that station in specific locations on the box. After the straps have been applied, the limit stop is moved out of the way of the box and it is moved to the next station where another sensor and limit stop operate to position the box for placement of an further pair of straps at predetermined different locations on the box. This process is repeated at each station until all straps have been applied.

Control means senses when a strap or straps have been missed, and operates to cause the box to be stopped at one or more positions in the recovery station for application of the missing strap or straps.

In a specific example of the machine, the strapping heads in the strapping head assemblies are based on the EAM Mosca KSR bundle strapper, which is capable of threading, cutting and welding a six hundred pound strap. These heads have been modified in the present invention to increase the throat size to accommodate an eighty-four inch throat.

Brief Description of the Drawings

The foregoing, as well as other objects and advantages of the invention, will become apparent from the following detailed description when considered in conjunction with the accompanying drawings, wherein like reference characters designate like parts throughout the several views, and wherein:

FIG. 1 is top perspective view of a bulk box strapping machine according to the invention.

FIG. 2 is a top plan view of a folded-flat bulk box that has been strapped with the machine of figure 1.

FIG. 3 is a perspective view of the bulk box in erected position.

FIGS. 4A and 4B are side elevational views of a strapping machine according to the invention, wherein FIG. 4A joins to FIG. 4B at the break A-B.

FIGS. 5A and 5B are top plan views of the machine of figures 4A and 4B, wherein FIG. 5A joins to FIG. 5B at the break A-B.

FIG. 6 is an enlarged end view in elevation of one of the strapping modules used in the machine of the invention.

FIG. 7 is a top plan view of the strapping module of figure 6.

FIG. 8 is a side view in elevation of one of the strapping head assemblies as used in the machine of the invention, showing a control panel and strap supply reel.

FIG. 9 is a top perspective view of one of the strapping head assemblies of the machine.

FIG. 10 is a top plan view of one of the strapping head assemblies.

FIG. 11 is a transverse sectional view taken along line 11-11 in figure 8.

FIG. 12 is a transverse sectional view taken along line 12-12 in figure 8.

Detailed Description of the Preferred Embodiments

Referring more specifically to the drawings, a bulk box strapping machine according to the invention is indicated generally at **10** in figures 1, 4A-4B and 5A-5B. In the embodiment illustrated and described herein, the machine is shown as having four strapping stations **11**, **12**, **13** and **14**, with stations **11**, **12** and **13** each having two strapping head assemblies **15** and **16**, whereby the machine is adapted to apply six straps to a box. Strapping station **14** comprises a recovery station, and as shown herein has two strapping head assemblies **17** and **18** that can apply any strap or straps not applied at a preceding station due to a malfunctioning head assembly or absence of strapping material, etc. The recovery strapping station **14**, or any of the other strapping stations, could include only one strapping head assembly, if desired.

Further, as illustrated and described herein the strapping stations are modular, whereby the stations may be increased or decreased in number, individually adjusted,

replaced, disabled or enabled without disturbing the other stations. It should be understood, however, that the strapping stations need not be modular, but a desired number of individual strapping head assemblies may be appropriately spaced from one another in the machine, depending upon the number of straps desired on the bulk box, with or without resorting to modular design.

Folded-flat bulk boxes **B** are supplied to the machine via a suitable infeed system **20**, although the boxes could be hand fed to the machine, if desired. The infeed system **20** includes an elevator means **21** for supporting a stack **S** of folded flat boxes **B** and for continuously moving the stack upwardly to position another box to be fed to the machine, and a reciprocating arm **22** connected with a source of vacuum (not shown) for picking up the top box in the stack and positioning it to be grabbed between a pinch roll **23** and drive roll or belt **24**.

After being fed into the machine, the boxes are continuously carried forward by suitable drive means such as, for example, endless belts **25**, **26** and **27**, as shown in figures 4A-4B, 5A-5B, 6 and 7, extending between the modules, or by rollers **R** as shown in figure 1.

Suitable sensors (not shown), such as photocells, microswitches, or the like, are positioned at each strapping station to detect the presence and position of a box at that station and cause a limit stop **28** to be moved into the path of the box to halt its movement at a predetermined position for applying straps at that station in specific locations on the box. The limit stop may comprise, for example, a pneumatic, hydraulic or electric drive **29** which moves a plunger into the path of the box in response to a signal from the sensor. The stops are located at predetermined distances downstream of their respective stations for stopping the boxes in a different position at each station to apply straps at different locations on the box than the straps applied at a preceding or succeeding station.

The boxes may be fed into the machine with either their top end or bottom end leading, but if the spacing of the straps is to be varied between the top and bottom ends of the box, appropriate adjustment will need to be made of the stop means and sensor means for each module.

For instance, at the first strapping station **11**, a pair of straps S_3 and S_6 are applied to the box at predetermined locations (see figure 2) in spaced apart relationship to one another (in the example shown the box is supplied bottom-end-first into the machine). The box is then advanced to the second strapping station **12**, where a second set of straps S_2 and S_5 are applied to the box at further predetermined locations, in spaced apart relationship to one another and to the first set of straps. Similarly, a third set of straps S_1 and S_4 are applied to the box at the third strapping station **13**. As noted previously, six boxes are in process in the machine at any given time, one in the infeed **20**, one at each station, and one in the discharge or outfeed stacker assembly **30**. The boxes at the various stations all stop at approximately the same time, but at a further advanced position in the succeeding stations, where the straps are applied, and the boxes again advanced in unison to the next station.

A folded-flat strapped box **B'** is shown in figure 2. Obviously, a greater or lesser number of straps can be applied by increasing or decreasing the number of stations or strapping head assemblies, or by inactivating one or more of the strapping stations or strapping head assemblies.

The strapped boxes, in their folded-flat condition, may then be shipped to a customer, where the boxes may be quickly and easily erected, as shown at **B"** in figure 3, with the straps applied.

The strapping head assemblies are identical to one another, and each includes an accumulator section **30** which forms a base to support the strapping head **31** and also provides a receptacle to store pieces of strapping material cut off when a strap

is secured around a box. A supply reel **32** and control panel **33** are supported near the strapping head assembly for supplying strapping to the strapping head assembly and controlling operation of the machine, respectively. As shown in figure 8 in dashed lines **34**, the strapping is fed from the reel over an idler wheel **35** and sprocket **36** and into the strapping head **31** of the strapping head assembly. The strapping is then fed by the strapping head through top and bottom tracks **37** and **38**, to form a loop of the strapping around the box positioned at that strapping head assembly. The free or lead end of the strapping is then gripped by the strapping head, secured to the length of strapping, and cut off, to form a loop of the strapping material closely encircling the box.

It will be noted from figures 1, 8 and 9 that the tracks of the strapping head assembly form a relatively wide, narrow opening **40** through which the box passes as it moves through the machine. In the particular construction illustrated and described herein, a pair of rollers **41** and **42** are positioned on opposite sides of the bottom track **38** to support the box. Other support and/or drive means for the box could be utilized, as desired and appropriate.

The supply reels **32** are secured by a single fastener so that they may be quickly removed and replaced with fresh reels as the strapping becomes exhausted on the first reel. The free end of the strapping is then grasped by the operator and inserted into the strapping head, which grips the strapping and automatically threads it through the tracks and back to the head.

As depicted in figures 1, 4A-4B and 5A-5B, the strapping head assemblies are arranged for applying six straps to a box, as shown in figure 2. In this arrangement, the strapping head assemblies **15** and **16** in each module are spaced eighteen inches apart, and place the straps at uniformly spaced intervals of six inches. If eight reinforcing straps are to be applied, the strapping head assemblies are spaced twenty

four inches apart, with straps S_1 and S_5 being applied together at one station; straps S_2 and S_6 applied at another station; straps S_3 and S_7 applied at a still further station; and straps S_4 and S_8 applied at yet another station.

It will be noted that the boxes are supplied to the machine in spaced apart relationship. This relationship is maintained throughout the sequence of steps in applying the desired number of straps by appropriate location and operation of the sensors, limit stops and feed means.

The control system detects whether any given strapping head assembly has or has not correctly applied a reinforcing strap to the box, and if a strap has been missed sends an appropriate command to the machine to stop the box at an appropriate position at the recovery station **14** so that the strapping head assemblies **17** and **18** at the recovery station can apply the missing strap or straps.

As seen best in figures 4A-4B, 5A-5B, 6 and 7, at least the upper flights of the belts **24** are supported on plates **45** extending between the modules. Motors **46** are connected through drive chains or belts **47**, or other suitable drive connection, with sprockets **48** to drive the belts carrying a box to each strapping station.

To facilitate maintenance, adjustment, replacement, etc., of the strapping head assemblies **15**, **16**, **17** and **18**, the head assemblies are mounted via rollers **50** on tracks **51** so that the heads may be moved laterally at least partially out of the machine.

The strapping head assembly and the machine of the invention enable boxes to be strapped much more quickly and economically than is possible with prior art systems and methods. Moreover, the machine may be quickly and easily adjusted to apply a greater or a lesser number of straps, and to position the straps with different spacing on the boxes.

While particular embodiments of the invention have been illustrated and described in detail herein, it should be understood that various changes and

modifications may be made to the invention without departing from the spirit and intent of the invention as defined by the scope of the appended claims.

What is claimed is: